1999 Coho Catch and Release Mortality Studies (Marine Recreational) in Northern British Columbia

S. Cox-Rogers

Fisheries and Oceans Canada
Science Branch, Pacific Region
417 2nd Avenue West
Prince Rupert, British Columbia
V8J 1G8

2004

Canadian Manuscript Report of Fisheries and Aquatic Sciences 2676

Fisheries and Oceans Canada | Pêches et Océans Canada

Canada

Canadian Manuscript Report of Fisheries and Aquatic Sciences

Manuscript reports contain scientific and technical information that contributes to existing knowledge but which deals with national or regional problems. Distribution is restricted to institutions or individuals located in particular regions of Canada. However, no restriction is placed on subject matter, and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Manuscript reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 1426 - 1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Manuscript reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Les rapports manuscrits contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui traitent des problèmes nationaux ou régionaux. La distribution en est limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports manuscrits peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports manuscrits sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annual des publications scientifiques et techniques du Ministère.

Les numéros 1 à 900 de cette série ont été publiés à titre de manuscrits (série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés comme manuscrits (série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros 901 à 1425 ont été publiés à titre de rapports manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 sont parus à titre de rapports manuscrits du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 1551.

Les rapports manuscrits sont produits a l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

104-06600/

Canadian Manuscript Report of
Fisheries and Aquatic Sciences 2676

2004

1999 COHO CATCH AND RELEASE MORTALITY STUDIES (Marine Recreational) IN NORTHERN BRITISH COLUMBIA

by

S. Cox-Rogers

Fisheries and Oceans Canada
Science Branch, Pacific Region
417 2nd Avenue West
Prince Rupert, British Columbia,
V8J 1G8

© Her Majesty the Queen in Right of Canada 2004
Cat. No. Fs 97-4/2676E ISSN 0706-6473

Correct citation for this publication:

Cox-Rogers, S. 2004. 1999 coho catch and release mortality studies (marine recreational) in northern British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2676: vi + 23 p.

CONTENTS

ABSTRACT iv

RÉSUMÉ v

LIST OF TABLES vi

INTRODUCTION 1

METHODS 1

- Study Locations 1
- Terminal Gears 2
- Fish Handling and Holding 2
- Statistical Analysis 4

RESULTS 4

- Landing Rates 4
- Mortality Rates 5
- Hook Location in the Landings and Mortalities 5
- Mortality Rates by Hook Location 6
- Bleeding 6
- Fish Size 6
- Handling 7
- Angler Activity 7
- Holding Time 8

DISCUSSION 8

RECOMMENDATIONS 10

ACKNOWLEDGEMENTS 10

REFERENCES 11

ABSTRACT

Cox-Rogers, S. 2004. 1999 coho catch and release mortality studies (marine recreational) in northern British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2676: vi + 23 p.

This report documents short-term (<24 hour) catch and release mortality rates for coho salmon in three marine recreational fisheries in northern British Columbia. The studies took place at Langara Island (Area 1), Dundas Island (Area 3), and Stevens Island (Area 4) from late July through late August 1999. Volunteer anglers and charter operators conducted the fishing. Three gear treatments were tested: a) motor-mooched herring b) trolled herring and c) trolled artificial lures. A total of 627 adult coho were captured and held for observation. A total of 62 coho died, resulting in a combined gear/study area mortality rate of 0.099. Short-term mortality rates were not significantly different ($p>0.05$) for coho captured on motor-mooched herring (0.049-0.111), trolled herring (0.057-0.064), or trolled artificial lures (0.059-0.167) at Dundas and Stevens Island. Short-term mortality rates were significantly different ($p<0.05$) for motor-mooched herring fished at Langara Island compared to Dundas and Stevens Island (0.221, 0.111, and 0.049 respectively). For all gear treatments tested, hook location was found to be the major factor associated with hooking mortality. A high proportion of the fish that died were those hooked in lethal areas (e.g. deep mouth) where hooking injuries to various blood vessels and nerves occurred. Fish size may also influence short-term mortality rates for some gear treatments, as larger coho captured on motor-mooched herring tended to be more aggressive and were able to ingest baits into the deep mouth area more easily than smaller coho.

RÉSUMÉ

Cox-Rogers, S. 2004. 1999 coho catch and release mortality studies (marine recreational) in northern British Columbia. Can. Manuscr. Rep. Fish. Aquat. Sci. 2676: vi + 23 p.

Ce rapport documente (< 24 heure) pour des saumons de coho dans trois pêches récréationnelles marines en Colombie britannique nordique. Les études ont eu lieu à l'île de Langara (secteur 1), île de Dundas (secteur 3), et île de Stevens (secteur 4) à partir de fin juillet par fin août 1999. Les anglers et les opérateurs volontaires de charte ont conduit la pêche. Trois traitements de vitesse ont été examinés: a) les harengs de moteur-mooched b) trolled des harengs et c) trolled des attraits artificiels. Un total de coho de l'adulte 627 ont été capturés et tenus pour l'observation. Un total de coho 62 est mort, ayant pour résultat un taux combiné de mortalité de secteur de gear/study de 0,099. Les taux à court terme de mortalité n'étaient pas sensiblement différents ($p>0.05$) pour le coho capturé sur les harengs de moteur-mooched (0,049-0,111), trolled les harengs (0,057-0,064), ou trolled les attraits artificiels (0,059-0,167) à l'île de Dundas et de Stevens. Les taux à court terme de mortalité étaient sensiblement différents ($p<0.05$) pour des harengs de moteur-mooched pêchés à l'île de Langara comparée à l'île de Dundas et de Stevens (0,221, 0,111, et 0,049 respectivement). Pour tous les traitements de vitesse examinés, l'endroit de crochet s'est avéré le facteur principal lié à la mortalité d'accrochage. Une proportion élevée des poissons qui sont morts étaient ceux accrochés dans des secteurs mortels (par exemple profondément bouche) où l'accrochage des dommages à de divers vaisseaux sanguins et nerfs s'est produit. Les poissons classent peuvent également influencer des taux à court terme de mortalité pour quelques traitements de vitesse, comme un plus grand coho capturé sur des harengs de moteur-mooched tendus pour être plus agressifs et pouvaient ingérer des amorces dans le secteur profond de bouche plus facilement qu'un plus petit coho.

LIST OF TABLES

Table 1. Landing rate summary (landings/hookups) by gear treatment (all species) for the 1999 coho catch and release studies 12

Table 2. Summary of mortality rates (mortalities/landings) by gear treatment for the 1999 coho catch and release studies.....13

Table 3. Percentage hook location in the landings and mortalities by gear treatment for the 1999 coho catch and release studies 14

Table 4. Summary of mortality rates by hook location by gear treatment for the 1999 coho catch and release studies 15

Table 5. Release status (dead or alive) after a maximum of 24 hours holding time by lethal and non-lethal hook locations and study area/gear for the 1999 coho catch and release studies. See text for descriptions of lethal and non-lethal hook locations.....16

Table 6. Summary of mortality rates for four categories of bleeding for the 1999 coho catch and release studies 17

Table 7. Mean nose-fork length (cm) in the landings and mortalities by gear treatment for the 1999 coho catch and release studies.....18

Table 8. Length-frequency distributions and corresponding mortality rates for coho captured on motor-mooched herring and trolled herring and artificial lures for the 1999 coho catch and release studies (all areas combined).....19

Table 9. Summary of mortality rates for four categories of scaling by gear treatment or the 1999 coho catch and release studies 20

Table 10. Summary of mortality rates for four categories of angler activity (when hooking fish) by gear treatment for the 1999 coho catch and release studies.....21

Table 11. Holding times (hours) for survivors and mortalities held in the holding tanks (all study areas and gear treatments combined) for the 1999 coho catch and release studies 22

Table 12. Summary of holding type and associated mortalities by gear treatment for the 1999 coho catch and release studies 23

INTRODUCTION

In 1999, the Canadian Department of Fisheries and Oceans, in conjunction with the Sport Fishing Institute of British Columbia and the Chatham Sound Charter Boat Association, conducted three catch and release studies of adult coho salmon captured in marine recreational fisheries in northern British Columbia. The studies took place at Langara Island (Area 1), Dundas Island (Area 3), and Stevens Island (Area 4) from late July through late August. The primary objective of all three studies was to gather data on short-term (<24 hour) hooking mortality rates for coho captured and released by anglers using similar types of fishing gear in different fishing locations in northern British Columbia. A secondary objective was to gather data on factors affecting hooking mortality, and to compare the findings with results from similar studies.

METHODS

Study Locations

The first study took place at Dundas Island north of Prince Rupert between July 26 and July 30, 1999. Three boats (two charter, one private) were hired by DFO to fish for coho using a) motor-mooched herring, b) trolled herring (with or without flashers) fished from downriggers, and c) trolled artificial lures (with or without flashers) fished from downriggers. Experienced anglers conducted the fishing and the same anglers fished aboard each boat most days. Up to four rods were fished from each boat. Fishing commenced at 0830 hrs and continued until early afternoon (1500 hrs). Independent observers were placed aboard each vessel to record data.

The second study took place at Stevens Island near Prince Rupert between August 12 and August 18, 1999. Six boats (three charter, three private) were hired by the Chatham Sound Charter Boat Association to fish for coho using a) motor-mooched herring, b) trolled herring (with or without flashers) fished from downriggers, and c) trolled artificial lures (with or without flashers) fished from downriggers. Experienced anglers conducted the fishing. Each of the boats fished one of three gear types each day and different anglers fished aboard each boat each day. Up to four rods were fished from each vessel. Fishing commenced at 0830 hrs and continued until early afternoon (1500 hrs). An independent observer was placed aboard each vessel to record data.

The third study took place at Langara Island off of the northern tip of the Queen Charlotte Islands between August 23 and August 30, 1999. Volunteer anglers (guided and unguided) from four fishing lodges were sampled for coho being captured during a chinook directed sport fishery. Coho were obtained from volunteer anglers accompanied by an observer, and from anglers observed to be playing coho during on-water monitoring by the study crew. Different anglers conducted the fishing each day. All of the coho were captured on motor-mooched herring. Two rods were usually fished from each boat.

Fishing commenced at daylight (0630) and continued until well into the evening (2000 hrs).

Terminal Gears

The three terminal gears tested were those standard to the north coast British Columbia marine recreational fishery. Motor-mooched herring, as tested at all three study locations, were fished head-off (cut-plug) on tandem 4/0 to 5/0 barbless J hooks. Light sliding weights (4oz to 8oz) were connected to the mainline above the swivel and leader system. Bait action was maintained using small auxiliary motors to hold boats relatively stationary to (or drifting slowly back with) the current when the tide was running. When currents were slack, anglers slowly trolling the baits through the water using forward movement of the boat maintained bait action. A preferred angle of 45 degrees or so was maintained on each line. Eddies and side currents off points close to shore were preferred mooching locations.

Trolled herring and trolled artificial lures, as tested at Dundas and Stevens Island, were fished from downriggers, either with or without flashers. Herring were placed in bait holders, or fished as cut-plugs, on single or tandem barbless 3/0 treble or single or tandem 4/0 to 5/0 J hooks. The artificial lures tested included a wide variety of spoons and hootchies incorporating single 3/0 to 6/0 Siwash-type J hooks. Constant forward movement of the boat maintained gear action.

Fish Handling and Holding

Coho were handled and held for observation the same way in all three studies. Coho were first played by anglers until they could be either a) netted by anglers in knotless-web landing nets supplied by Fisheries and Oceans Canada or b) tailed by anglers with a gloved hand at the side of the boat. Once netted or tailed, observers recorded biological and specific hook location information for each fish on a standardised data form. If the hook (s) was not visible or easily extracted because of deep hooking, leaders were often cut by anglers and the hook (s) was left in the fish to avoid further injury.

Following inspection, landed fish were either transferred directly to one of two live-tank equipped 5.3m retrieval Zodiacs, or held for retrieval in 1.2m fish holding bags (pliant vinyl tubes) tethered to the stern of each boat until pick-up occurred. Upon retrieval, each coho was tagged and transported to a holding site in close proximity to the fishing grounds within each study location. Transport times between the fishing and holding sites ranged between 2 and 10 minutes depending upon sea conditions. As many as six coho were transported at one time using this approach. VHF radio contact was maintained between the holding site and the Zodiacs at all times.

Data records kept by the observers for each coho landed included the playing time, the landing method, the condition upon landing, angler actions in hooking the fish,

the location of each hook (s), the degree of hook damage, the degree of bleeding, the degree of scale loss, and a fish tag number. An activity log for each rod being fished aboard each boat was also kept by each observer to record the total number of strikes, hook-ups, losses and landings for each rod. The observers recorded three major categories of hooking location:

Deep Mouth: for hooks located in the pharynx/gill area, including hooks swallowed or lodged into the pharynx, gill arches, or other posterior portions of the mouth. Hooks located in this area were not easily seen by casual inspection or easily removed and were often left in the fish. Specific hook location categories for the deep mouth included the pharynx, gills, swallowed, and "other".

Outer Mouth: for hooks located in the outer jaw region, not including areas associated with the deep mouth region, but including the upper and lower jaws, the roof or floor of the mouth, the maxillary, the tongue, or other anterior portions of the mouth. Hooks located in this area were easily seen by casual inspection and easily removed. Specific hook location categories for the outer mouth included the upper jaw, lower jaw, roof, maxillary, tongue, and "other".

Outside of the Mouth: for hooks located outside of the Outer mouth and jaw area but including the outer head and body, eye, fins, tail, isthmus, and other locations not associated with the mouth. Hooks in this area were easily seen by casual inspection and easily removed. Specific hook location categories for the outside mouth included the head, body, fin (s), tail, isthmus, eye and "other".

At Dundas Island and Stevens Island, fish were held in a 3m X 3mX 3m net pen and in six live-tanks aboard a specially equipped holding vessel contracted to Fisheries and Oceans Canada. At Langara Island, adverse currents precluded using the net pen for holding fish, and so all fish were held in the live-tanks aboard the holding vessel. The holding sites for each study were chosen to be as close as possible to the fishing grounds to minimize transport times.

Upon arrival at the holding site, each coho was measured, sexed, tissue sampled (caudal punched) for later DNA analysis, and transferred into either the net pen or into one of the holding tanks maintained on the aft deck of the holding vessel. Dead coho were removed from each holding tank as they were found during hourly inspections, while dead coho in the net pen could not be removed (accessed) until the pen was cleared the morning following the day of capture. Coho were held in the net pen and in the holding tanks for periods of up to 24 hours. All coho were released prior to commencement of the next day's fishing.

Statistical Analysis

Field data were entered into a spreadsheet database for analysis. For the different gear and method treatments in each study, mortality rates were calculated using a simple proportion calculation from a binomial distribution (Zar 1984). The observed mortality rate was calculated as:

1) $$\hat{p} = \frac{X}{n}$$

where $\hat{p}$ is the mortality rate estimate, X is the number of fish mortalities, and n is the total number of fish sampled. Landing rates by hook treatment type were calculated the same way. Using a relationship between the F distribution and the binomial distribution, lower (L_1) and upper (L_2) confidence limits about p were calculated (Zar 1984):

2) $$L_1 = \frac{X}{X + (n - X + 1) F_{0.05(2),\nu_1,\nu_2}} \quad \text{with} \quad \nu_1 = 2(n - X + 1) \quad \text{and} \quad \nu_2 = 2X$$

3) $$L_2 = \frac{(X+1) F_{0.05(2),\nu_1',\nu_2'}}{n - X + (X+1) F_{0.05(2),\nu_1',\nu_2'}} \quad \text{with} \quad \nu_1' = 2(X+1) \quad \text{and} \quad \nu_2' = 2(n - X)$$

Contingency analysis (Systat 1996) was used to assess the dependence of overall mortalities on various factors potentially affecting mortality. Observed landing and mortality frequencies for the study period (columns) by treatment factor (rows) were tabulated in contingency matrices and the calculated Chi-square statistic:

3) $$\chi^2 = \Sigma\Sigma \frac{(f_{ij} - F_{ij})}{F_{ij}}$$ where f_{ij} = observed frequency of row i and column j

and F_{ij} = expected frequency of row i and column j

was used to test the null hypothesis of no significant difference in mortalities among the various factors at the 5% level of significance.

RESULTS

Landing Rates

Landing rates were recorded by the onboard observers for each rod being fished and represent the proportion of fish hooked and played that were actually landed. As salmon played and lost could not be identified as to definite species, the landing rates reported in Table 1 are for all salmon encountered and therefore provide a general

indication of success by gear treatment. The majority of the fish lost were expected to have been coho, although pink salmon were prevalent in some areas as well.

Landing rates were generally higher for the trolled gear treatments compared to the motor-mooched gear treatments (Table 1). Landing rates for motor-mooched herring were 0.570 at Langara Island, 0.419 at Dundas Island, and 0.500 at Stevens Island. Landing rates for trolled herring (with or without flashers) were 0.589 at Dundas Island and 0.598 at Stevens Island. Landing rates for trolled artificial lures (with or without flashers) were 0.618 at Dundas Island and 0.692 at Stevens Island. The fate of lost salmon could not be ascertained, but some component may have died as a result of being hooked, played, and lost (e.g. drop-off mortality). Several anglers suggested that landing rates would have been higher had barbless hooks not been used, but no data are available to substantiate this.

Mortality Rates

A total of 627 adult coho were captured and held for short-term observation (<24 hours). A total of 62 fish died, resulting in a combined gear/study area mortality rate of 0.099 (Table 2). Mortality rates were not significantly different ($p>0.05$) among the various gear treatments tested at Dundas and Stevens Island (range 0.049 – 0.167, Table 2)) but they were significantly different ($p<0.05$) for motor-mooched herring tested at Dundas and Stevens Island compared to Langara Island (range 0.049 – 0.221, Table 2).

Hook Location in the Landings and Mortalities

The most common hook location in the landings was the outer mouth (Table 3). Across all gear treatments, the proportion of fish landed with one hook in the outer mouth ranged from 36.8% for motor-mooched herring at Langara Island to 77.5% for trolled lures at Stevens Island. A surprisingly high proportion of landings were also hooked outside of the mouth, probably due to the tendency of coho to slash at gear prior to hook-up, or as a result of hooks tearing free during playing and re-hooking elsewhere.

Across all gear treatments, the proportion of coho landed with one hook outside of the mouth ranged from 14.2% for trolled lures at Stevens Island to 28.2% for trolled lures at Dundas Island (Table 3). The proportion of coho landed with one hook in the deep mouth ranged from 1.5% for trolled herring at Stevens Island to 13.0% for motor-mooched herring at Dundas Island. However, when multiple hooks are considered, the proportion of coho landed with at least one hook in the deep mouth ranged from just 2.2% for trolled herring at Stevens Island to 24.3% for motor-mooched herring at Langara Island, the highest of all gear treatments tested (Table 3).

Hook location for the fish that died varied by gear treatment (Table 3). For coho captured on motor-mooched herring, the most common hook location in the mortalities was in the deep mouth (Table 3). The proportion of mortalities having one hook located in the deep mouth was 38.1% at Langara Island, 66.7% at Dundas Island, and 50.0% at

Stevens Island. For coho captured on trolled herring, the most common hook locations in the mortalities were the outer or outside mouth (Dundas Island 75.0% - 100.0%, Stevens Island 50.0% - 66.7%), where tearing or penetration wounds to the base of the tongue, eye, isthmus, or head (brain) were observed.

Mortality Rates by Hook Location

Hooking mortality was highest for those coho with hooks located in the deep mouth area, and lowest for those coho with hooks located in the outer or outside mouth area (Table 4). For coho hooked in the deep mouth by one hook alone, the total (combined treatment) mortality rate was 0.576, compared to just 0.059 and 0.099 for fish hooked in the outer mouth or outside mouth by one hook alone. One exception was for trolled artificial lures tested at Dundas Island and Stevens Island, where hooks located in the outer or outside mouth also resulted in some high mortality rates (0.318 and 0.250, Table 4). These fish were those that had penetration wounds into the brain or eye, primarily the result of using large-gap Siwash hooks (e.g. >5/0).

An overall comparison of release status (dead or alive) after the maximum 24 hours holding time by lethal and non-lethal hook locations, for each gear treatment and study area, is presented in Table 5. Across all gears and study areas, the percentage of coho hooked in non-lethal areas that died was just 6.33% (range 2.74% to 9.46%, Table 5). Across all gears and study areas, the percentage of coho hooked in lethal areas that died was 44.83% (range 0.00% to 66.67%, Table 5). As not all coho that were hooked in lethal areas died (Table 5), it's evident that coho can survive if hooking injuries are not too severe.

Bleeding

Mortality rates were highest for those fish exhibiting heavy bleeding (0.543) and lowest for those fish exhibiting no bleeding (0.045) (Table 6). For coho captured on motor-mooched herring, some degree of bleeding was observed in 85.7% of the mortalities at Langara Island, 83.3% of the mortalities at Dundas Island, and 66.6% of the mortalities at Stevens Island. For coho captured on trolled herring, some degree of bleeding was observed in 100.0% of the mortalities at Dundas Island and 50.0% of the mortalities at Stevens Island. For coho captured on trolled lures, some degree of bleeding was observed in 100.0% of the mortalities at Dundas Island and 83.3% of the mortalities at Stevens Island. For all gears tested, bleeding wounds were most often associated with hooks located in the deep mouth area, where ripping or puncture wounds to blood vessels associated with the gill arches and heart occurred.

Fish Size

Coho were significantly larger ($p<0.05$) at Langara Island compared to Dundas Island and Stevens Island. Mean nose-fork lengths were highest for coho landed on motor-mooched herring at Langara Island (64.3 cm) and lowest for coho landed on

motor-mooched herring and trolled herring (without flashers) at Dundas Island (59.1 cm) (Table 7). For the fish that died, mean nose-fork lengths were highest for coho captured on motor-mooched herring at Langara Island (68.1 cm) and lowest for coho captured on trolled herring (without flashers) at Dundas Island (55.0 cm) (Table 7). Coho that were larger than 60cm or so, captured on motor-mooched herring, exhibited higher mortality rates compared to coho of the same size captured on trolled herring or lures (Table 8).

Handling

Scale loss and subsequent dehydration associated with handling has also been considered to be a source of mortality in catch and release salmon fisheries (McNair 1991, McNair 1999). Scale loss was found to be minimal across all gear treatments and study locations for the studies conducted at Langara Island, Dundas Island, and Stevens Island in 1999, primarily because of the soft-mesh nets used to land fish and because the majority of fish landed were not brought aboard where physical contact with the boat could occur. Just 7.9% of the fish landed exhibited moderate to heavy scaling, of which 1.3%, eventually died. However, across all gear treatments), mortality rates were higher for those fish exhibiting heavy scaling (0.333) compared to those exhibiting no scaling (0.070) or light to moderate scaling (0.105) (Table 9). Almost all of the scaled fish were also those that had been hooked in critical areas and exhibited bleeding upon landing, and so the influence of scale loss on mortality was assumed to be minor.

Angler Activity

Angler activity, or the actions of anglers in securing a hook-up, has been suggested as a possible factor affecting mortality in catch and release salmon fisheries. For example, anglers, when motor-mooching, can encourage fish to take baits by "feeding" free line to a difficult fish, which may result in a higher incidence of deep hooking. In contrast, fish striking off of downriggers often set the hook themselves without any direct angler action other than picking up the rod.

Angler activity was subjectively evaluated by observers at the time of hook-up as involving no action on the part of the angler (e.g. picking up rod), striking the rod forcefully to set hooks, feeding line to encourage a hook-up, or some combination of all three actions (Table 10).

In general, mortality rates appeared to increase as angler activity moved from "no action" to "feeding line" (Table 10) but sufficient information was not collected to quantify this assessment. In all study areas, experienced anglers tended to react more "quickly" to strikes and were more successful in hooking fish compared to less experienced anglers, who tended to have longer reaction times and were prone to missing strikes more often. For trolled herring or artificial lures (with or without flashers) fished from downriggers, the most common angler activity was either picking up the rod following a strike (66%) or striking to set the hooks (33%). For motor-mooched herring observed at Langara Island, the most common angler activity was simply striking to set

the hooks (59%) or simply picking up the rod (28%). Most coho at Langara Island took the baits forcefully and a very low percentage of anglers (3%) fed line to encourage a hook-up, although 10% were observed to use a combination of methods to encourage a hook-up.

Holding Time

For fish held in the holding tanks (the net pen could not be checked at regular intervals), the mean holding time for the survivors was 18.66 hours, compared to a mean holding time for the mortalities of 4.83 hours (Table 11). 62.3% of the fish that died did so within the first 4 hours of holding, 75.5% died within the first six hours of holding, and 86.8% died within the first ten hours of holding. Very few of the fish died after the first 10 hours of holding (13.2%) and most of these were fish that had died in the tanks over night, so that the actual time of death could not be accurately established.

The influence of holding coho in holding tanks or the net pen was compared to see if bias associated with the holding protocols was influencing the results. Mortality rates for coho held in the net pens or the holding tanks were not significantly different ($p > 0.05$) among study areas or gear treatments, suggesting that the holding environment was not a major factor determining mortality rates for these studies (Table 12).

DISCUSSION

The objective of the 1999 coho catch and release studies was to gather data on short-term (<24 hour) hooking mortality rates for coho captured and released by anglers using similar types of fishing gear in different fishing locations in northern British Columbia. A secondary objective was to gather data on factors affecting hooking mortality, and to compare the findings with results from similar studies.

Short-term mortality rates were not significantly different ($p > 0.05$) for coho captured on motor-mooched herring (0.049-0.111), trolled herring (0.057-0.064), or trolled artificial lures (0.059-0.167) at Dundas and Stevens Island. Short-term mortality rates were significantly different ($p < 0.05$) for motor-mooched herring fished at Langara Island compared to Dundas and Stevens Island (0.221, 0.111, and 0.049 respectively). Across all gear types and study areas, the combined short-term mortality rate was 0.099. Short-term hooking mortality rates were associated with hook location and the incidence of bleeding. For all of the gear types tested, fish hooked in the deep mouth area exhibited the highest mortality rates and were often bleeders. The proportion of fish hooked in the deep mouth was higher for motor-mooched herring, compared to trolled herring or artificial lures in all study locations, suggesting that mooched baits were more easily or readily ingested by coho than trolled lures or baits. McNair (1999) noted similar findings, and concluded that mortality rates likely vary along a continuum of "active" vs "passive" presentations, with the more passive presentations causing higher hooking mortality by making it easier for salmon to ingest lures or baits.

Fish size also appears to be a factor, as larger coho captured at Langara Island (mean length 64.3 cm) had higher mortality rates than smaller coho captured at Dundas or Stevens Island (mean lengths 59.3 cm and 60.1 cm). Larger coho tended to be more aggressive and were able to ingest baits into the deep mouth area more easily than smaller coho. Fish size has been identified as a factor affecting mortality in catch and release salmon fisheries by influencing the frequency of wounds to critical locations (Muoneke and Childress 1994, McNair 1999). Similar findings were noted at Work Channel in 1998 (Cox-Rogers, in press), where the average size of coho captured on motor-mooched herring was high (mean length 69.8 cm), the majority of fish that died were deeply hooked, and the short term mortality rate was 0.260. McNair (1998) found the highest incidence of critical hook wounds occurred for salmon >60cm caught with mooching techniques.

The actual causes of death for coho held in these studies was not determined, but would include a) physiological stress associated with playing, handling and holding, and b) direct physical injury associated with hooking wounds, nerve damage, blood loss, and scale loss. Quantifying the effect of physiological stress was beyond the scope of this study, but the holding observations and summaries of release status show that the majority of fish with minor physical hooking injuries survived, suggesting that stress factors due to playing, handling, and holding, were probably of minor importance. In contrast, the holding observations show that many of fish with major physical hooking injuries died, suggesting that physical injury is very important. While some bias due to holding and handling no doubt occurred, it is assumed to be small.

While the studies conducted in 1999 provide information about mortality rates for specific gears at specific locations at specific times, little was learned about the seasonal variability of mortality rates. For example, its not clear what mortality rate should be applied to coho captured and released in the same study locations at different times of the year. Currently in British Columbia, a single mortality rate of 10% is applied to coho released in marine recreational fisheries, regardless of the time, area, or gears being used. In 1992, short-term mortality rates for coho captured on motor-mooched herring at Langara Island were one half lower (e.g. 0.116) than those found in 1999 (Terry Gjernes, Fisheries and Oceans Canada. pers. comm.) These contrasting results suggest that mortality rates in marine recreational fisheries may not be as stable as currently assumed. From an assessment perspective, establishing the seasonal range of mortality rates for specific gears in specific north coast marine recreational should be considered. The issue of drop-off mortality and longer-term survival (e.g. >24 hour) in these fisheries also needs to be addressed.

RECOMMENDATIONS

1. Based on information gathered from three studies conducted in 1999, short-term hooking mortality rates for coho captured in marine recreational fisheries in northern British Columbia can be expected to range between 0.049 and 0.221 depending upon the gear, the area, and the time of year in question. Managers should provide estimates of fishery impacts that incorporate available mortality rate information for specific gears and areas.

2. Further studies should focus on the degree of seasonal variation in short-term mortality rates, by gear treatment, within specific fisheries where exploitation rates are significant or where the impact of catch and release fishing is of management concern. Assessments of drop-off mortality and longer-term survival (e.g. >24 hour) in these fisheries should also be considered.

ACKNOWLEDGEMENTS

The assistance of the guides and volunteers who participated in this study was greatly appreciated. Special thanks to Dave Peacock (Fisheries and Oceans Canada) and Ivan Winther (Fisheries and Oceans Canada) for several helpful discussions regarding the problems associated with catch and release mortality estimation in marine recreational fisheries.

REFERENCES

Cox-Rogers, S. 2004. Catch and release mortality rates for coho salmon captured on motor-mooched cut-plug herring near Work Channel, British Columbia, in 1998. Can. Manuscr. Rep. Fish. Aquat. Sci. 2677: 28 p.

McNair, 1991. Hooking mortality study final project report. Saltonstall-Kennedy Grant NA89AB-H-00012. Natural Resources Consultants Inc, Seattle, Washington.

McNair 1998. Final Progress Report for NEAP AT-SEA Research Projects. Volume II. Technical Reports. Natural Resource Consultants Inc, Seattle, Washington.

McNair 1999. A Review of Recent Hooking Mortality Studies. Natural Resources Consultants Inc. Seattle, Washington. 50 p.

Muoneke, M.I., and W.M. Childress. 1994. Hooking Mortality: A Review for Recreational Fisheries. Rev. Fish. Sci. 2(2): 123-156.

Systat (1996). Statistics. SPSS Inc. Chicago, IL.

Zar, J.H. 1984. Biostatistical Analysis. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Dundas Island	Hookups	Landings	Landing Rate
Motor-mooched herring	148	62	0.419
Trolled herring	151	89	0.589
Trolled lures	228	141	0.618
Stevens Island			
Motor-mooched herring	226	113	0.500
Trolled herring	261	156	0.598
Trolled lures	227	157	0.692
Langara Island			
Motor-mooched herring	172	98	0.570

Table 1. Landing rate summary (landings/hookups) by gear treatment (all species) for the 1999 coho catch and release studies.

Dundas Island	Landings	Mortalities	Mortality Rate	95% lower c.l.	95% upper c.l.
Motor-mooched herring	54	6	0.111	0.042	0.229
Trolled herring (wo/flashers)	65	4	0.062	0.017	0.154
Trolled herring (w/flashers)	0	0	0.000	0.000	0.000
Trolled lures (wo/flashers)	17	1	0.059	0.001	0.309
Trolled lures (w/flashers)	61	6	0.098	0.036	0.205
All Gear	197	17	0.086	0.052	0.139
Stevens Island					
Motor-mooched herring	81	4	0.049	0.014	0.124
Trolled herring (wo/flashers)	87	5	0.057	0.019	0.131
Trolled herring (w/flashers)	47	3	0.064	0.013	0.181
Trolled lures (wo/flashers)	12	2	0.167	0.021	0.497
Trolled lures (w/flashers)	108	10	0.093	0.045	0.166
All Gear	335	24	0.072	0.047	0.103
Langara Island					
Motor-mooched herring	95	21	0.221	0.151	0.328
All Areas/All Gears	627	62	0.099	0.078	0.126

Chi-square tests for Independence

Test: among areas	Chi-square	df	p
Motor-mooched herring	9.481	2	0.009
Trolled herring (wo/flashers)	0.009	1	0.921
Trolled herring (w/flashers)	-	-	-
Trolled lures (wo/flashers)	0.706	1	0.400
Trolled lures (w/flashers)	0.012	1	0.911
Test: within areas			
Dundas Island: All gears	1.016	3	0.797
Stevens Island: All gears	2.704	4	0.608

Table 2. Summary of mortality rates (mortalities/landings) by gear treatment for the 1999 coho catch and release studies.

	Motor-Mooched Herring			Trolled Herring		Trolled Lures		
	Langara	Dundas	Stevens	Dundas	Stevens	Dundas	Stevens	All Gear
Landings								
Deep Mouth	11.6%	13.0%	4.9%	4.6%	1.5%	2.6%	3.3%	5.3%
Outer Mouth	36.8%	50.0%	48.1%	49.2%	70.1%	66.7%	77.5%	59.3%
Outside Mouth	21.1%	25.9%	18.5%	23.1%	20.9%	28.2%	14.2%	20.9%
Deep and Outer	5.3%	0.0%	2.5%	3.1%	0.0%	2.6%	0.0%	1.8%
Deep and Outside	4.2%	1.9%	1.2%	3.1%	0.7%	0.0%	0.0%	1.4%
Outer and Outside	10.5%	3.7%	11.1%	7.7%	3.7%	0.0%	3.3%	5.6%
Outer and Outer	1.1%	1.9%	2.5%	6.2%	2.2%	0.0%	1.7%	2.1%
Outside and Outside	6.3%	3.7%	9.9%	1.5%	0.7%	0.0%	0.0%	2.9%
Deep and Deep	3.2%	0.0%	1.2%	1.5%	0.0%	0.0%	0.0%	0.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Mortalities								
Deep Mouth	38.1%	66.7%	50.0%	25.0%	25.0%	0.0%	16.7%	30.6%
Outer Mouth	19.0%	33.3%	25.0%	75.0%	50.0%	0.0%	66.7%	35.5%
Outside Mouth	9.5%	0.0%	25.0%	0.0%	25.0%	100.0%	8.3%	21.0%
Deep and Outer	9.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%
Deep and Outside	9.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.2%
Outer and Outside	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	1.6%
Outer and Outer	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Outside and Outside	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Deep and Deep	14.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3. Percentage hook location in the landings and mortalities by gear treatment for the 1999 coho catch and release studies.

Location	Motor-Mooched Herring			Trolled Herring		Trolled Lures		All Gear
	Langara	Dundas	Stevens	Dundas	Stevens	Dundas	Stevens	
Deep Mouth	0.727	0.571	0.500	0.333	1.000	0.000	0.500	0.576
Outer Mouth	0.114	0.074	0.026	0.094	0.043	0.000	0.086	0.059
Outside Mouth	0.100	0.000	0.067	0.000	0.071	0.318	0.059	0.099
Deep and Outer	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.182
Deep and Outside	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.222
Outer and Outside	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.029
Outer and Outer	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Outside and Outside	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Deep and Deep	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.600
All	0.221	0.111	0.049	0.062	0.060	0.090	0.100	0.099

Table 4. Summary of mortality rates by hook location by gear treatment for the 1999 coho catch and release studies

		Hook Location					
		Lethal		Non-Lethal			
Area	Status	n	%	n	%	Total	
Langara Mooch	Dead	15	65.22%	6	8.33%	21	22.11%
	Alive	8	34.78%	66	91.67%	74	77.89%
	Total	23		72		95	
Dundas Mooch	Dead	4	50.00%	2	4.35%	6	11.11%
	Alive	4	50.00%	44	95.65%	48	88.89%
	Total	8		46		54	
Stevens Mooch	Dead	2	25.00%	2	2.74%	4	4.94%
	Alive	6	75.00%	71	97.26%	77	95.06%
	Total	8		73		81	
Dundas Troll Bait	Dead	1	12.50%	3	5.26%	4	6.15%
	Alive	7	87.50%	54	94.74%	61	93.85%
	Total	8		57		65	
Dundas Troll Lure	Dead	0	0.00%	7	9.46%	7	8.97%
	Alive	4	100.00%	67	90.54%	71	91.03%
	Total	4		74		78	
Stevens Troll Bait	Dead	2	66.67%	6	4.58%	8	5.97%
	Alive	1	33.33%	125	95.42%	126	94.03%
	Total	3		131		134	
Stevens Troll Lure	Dead	2	50.00%	10	8.62%	12	10.00%
	Alive	2	50.00%	106	91.38%	108	90.00%
	Total	4		116		120	
All Gears/Areas	Dead	26	44.83%	36	6.33%	62	9.89%
	Alive	32	55.17%	533	93.67%	565	90.11%
	Total	58		569		627	

Table 5. Release status (dead or alive) after a maximum of 24 hours holding time by lethal and non-lethal hook locations and study area/gear for the 1999 coho catch and release studies. See text for descriptions of lethal and non-lethal hook locations.

Dundas Island	No Bleeding Mortality Rate	Light Bleeding Mortality Rate	Moderate Bleeding Mortality Rate	Heavy Bleeding Mortality Rate
Motor-mooched herring	0.040	0.000	0.167	0.800
Trolled herring (wo/flashers)	0.000	0.000	0.154	0.400
Trolled herring (w/flashers)	0.000	0.000	0.000	0.000
Trolled lures (wo/flashers)	0.000	0.100	0.000	0.000
Trolled lures (w/flashers)	0.000	0.000	0.250	0.286
All Gear	0.020	0.011	0.179	0.471
Stevens Island				
Motor-mooched herring	0.043	0.038	0.000	0.250
Trolled herring (wo/flashers)	0.059	0.000	0.000	0.500
Trolled herring (w/flashers)	0.029	0.111	0.000	0.500
Trolled lures (wo/flashers)	0.125	0.000	0.000	0.500
Trolled lures (w/flashers)	0.018	0.000	0.333	0.667
All Gear	0.041	0.022	0.172	0.500
Langara Island				
Motor-mooched herring	0.073	0.219	0.273	0.727
All Areas/All Gears	0.042	0.047	0.190	0.543

Table 6. Summary of mortality rates for four categories of bleeding for the 1999 coho catch and release studies.

	Landings			Mortalities		
Dundas Island	n	Mean	StdDev	n	Mean	StdDev
Motor-mooched herring	54	59.1	5.92	6	57.8	5.31
Trolled herring (wo/flashers)	65	59.1	6.05	4	55.0	11.17
Trolled herring (w/flashers)	0	0.0	0.00	0	0.0	0.00
Trolled lures (wo/flashers)	17	60.8	5.88	1	55.0	-
Trolled lures (w/flashers)	61	59.3	8.18	6	60.3	6.19
All Gear	197	59.3	7.00	17	57.9	6.69
Stevens Island						
Motor-mooched herring	81	60.6	6.50	4	63.8	6.24
Trolled herring (wo/flashers)	87	60.7	4.23	5	65.0	5.43
Trolled herring (w/flashers)	47	60.0	7.55	3	60.7	2.08
Trolled lures (wo/flashers)	12	59.2	3.49	2	56.5	2.12
Trolled lures (w/flashers)	108	59.5	6.06	10	59.1	4.70
All Gear	335	60.1	5.92	24	61.1	4.57
Langara Island						
Motor-mooched herring	95	64.3	5.82	21	68.1	5.70
All Areas/All Gear	627	60.5	6.37	62	62.7	5.54

Table 7. Mean nose-fork length (cm) in the landings and mortalities by gear treatment for the 1999 coho catch and release studies.

Length nterval (cm)	Motor-Mooched Herring			Trolled Herring and Lures		
	Landings	Mortalities	Mortality Rate	Landings	Mortalities	Mortality Rate
40	0	0	0.000	2	0	0.000
42	1	0	0.000	3	0	0.000
44	1	0	0.000	1	0	0.000
46	1	0	0.000	4	2	0.500
48	4	0	0.000	5	0	0.000
50	6	0	0.000	15	0	0.000
52	6	1	0.167	19	1	0.053
54	12	1	0.083	18	3	0.167
56	13	1	0.077	34	2	0.059
58	16	3	0.188	52	3	0.058
60	35	5	0.143	57	7	0.123
62	28	1	0.036	63	5	0.079
64	27	1	0.037	49	3	0.061
66	27	2	0.074	21	0	0.000
68	25	4	0.160	32	3	0.094
70	10	5	0.500	11	0	0.000
72	10	3	0.300	5	1	0.200
74	2	1	0.500	5	1	0.200
76	3	2	0.667	0	0	0.000
78	2	2	1.000	0	0	0.000
80	0	0	0.000	0	0	0.000
82	1	0	0.000	0	0	0.000
84	0	0	0.000	0	0	0.000
86	0	0	0.000	1	0	0.000
88	0	0	0.000	0	0	0.000
90	0	0	0.000	0	0	0.000
Total	230	32	0.139	397	31	0.078

Table 8. Length-frequency distributions and corresponding mortality rates for coho captured on motor-mooched herring and trolled herring and artificial lures for the 1999 coho catch and release studies (all areas combined).

Table 9. Summary of mortality rates for four categories of scaling by gear treatment for the 1999 coho catch and release studies.

Dundas Island	No Scaling Mortality Rate	Light Scaling Mortality Rate	Moderate Scaling Mortality Rate	Heavy Scaling Mortality Rate
Motor-mooched herring	0.059	0.094	0.333	0.500
Trolled herring (wo/flashers)	0.100	0.045	0.000	0.333
Trolled herring (w/flashers)	0.000	0.000	0.000	0.000
Trolled lures (wo/flashers)	0.000	0.083	0.000	0.000
Trolled lures (w/flashers)	0.125	0.071	0.125	0.333
All Gear	0.075	0.069	0.105	0.375
Stevens Island				
Motor-mooched herring	0.073	0.025	0.000	0.000
Trolled herring (wo/flashers)	0.040	0.074	0.000	0.000
Trolled herring (w/flashers)	0.053	0.077	0.000	0.000
Trolled lures (wo/flashers)	0.333	0.125	0.000	0.000
Trolled lures (w/flashers)	0.031	0.116	0.143	0.000
All Gear	0.058	0.081	0.063	0.000
Langara Island				
Motor-mooched herring	0.120	0.246	0.333	0.500
All Areas/All Gears	0.070	0.105	0.105	0.333

Table 9. Summary of mortality rates for four categories of scaling by gear treatment for the 1999 coho catch and release studies.

Dundas Island	No Angler Action Mortality Rate	Striking Action Mortality Rate	Feeding Line Mortality Rate	Combined Actions Mortality Rate
Motor-mooched herring	0.091	0.077	0.500	0.500
Trolled herring (wo/flashers)	0.094	0.030	0.000	0.000
Trolled herring (w/flashers)	0.000	0.000	0.000	0.000
Trolled lures (wo/flashers)	0.000	0.250	0.000	0.000
Trolled lures (w/flashers)	0.100	0.097	0.000	0.000
All Gear	0.081	0.075	0.500	0.500
Stevens Island				
Motor-mooched herring	0.037	0.039	0.500	0.000
Trolled herring (wo/flashers)	0.055	0.069	0.000	0.000
Trolled herring (w/flashers)	0.050	0.167	0.000	0.000
Trolled lures (wo/flashers)	0.100	0.500	0.000	0.000
Trolled lures (w/flashers)	0.062	0.200	0.000	0.000
All Gear	0.056	0.097	0.333	0.000
Langara Island				
Motor-mooched herring	0.234	0.150	0.000	0.280
All Areas/All Gears	0.087	0.092	0.250	0.242

Table 10. Summary of mortality rates for four categories of angler activity (when hooking fish) by gear treatment for the 1999 coho catch and release studies.

Holding Time (hrs)	Survivors	%	Mortalities	%
0	0	0.0%	10	18.9%
1	0	0.0%	5	9.4%
2	0	0.0%	8	15.1%
3	0	0.0%	5	9.4%
4	0	0.0%	5	9.4%
5	0	0.0%	4	7.5%
6	0	0.0%	3	5.7%
7	6	1.4%	1	1.9%
8	16	3.8%	1	1.9%
9	5	1.2%	2	3.8%
10	15	3.6%	2	3.8%
11	12	2.9%	0	0.0%
12	1	0.2%	0	0.0%
13	2	0.5%	0	0.0%
14	2	0.5%	0	0.0%
15	3	0.7%	1	1.9%
16	16	3.8%	1	1.9%
17	23	5.5%	0	0.0%
18	27	6.4%	2	3.8%
19	24	5.7%	0	0.0%
20	50	11.9%	2	3.8%
21	62	14.8%	0	0.0%
22	60	14.3%	0	0.0%
23	82	19.6%	1	1.9%
24	13	3.1%	0	0.0%
mean time	18.66		4.83	
Total	419	100.0%	53	100.0%

Table 11. Holding times (hours) for survivors and mortalities held in the holding tanks (all study areas and gear treatments combined) for the 1999 coho catch and release studies.

Dundas Island	Holding Tanks Landings	Mortalities	Mortality Rate	Net pen Landings	Mortalities	Mortality Rate
Motor-mooched herring	39	3	0.077	15	3	0.200
Trolled herring (wo/flashers)	40	2	0.050	25	2	0.080
Trolled herring (w/flashers)	0	0	0.000	0	0	0.000
Trolled lures (wo/flashers)	12	0	0.000	5	1	0.200
Trolled lures (w/flashers)	48	5	0.104	13	1	0.077
All Gear	139	10	0.072	58	7	0.121
Stevens Island						
Motor-mooched herring	61	3	0.049	20	1	0.050
Trolled herring (wo/flashers)	58	4	0.069	29	1	0.034
Trolled herring (w/flashers)	41	3	0.073	6	0	0.000
Trolled lures (wo/flashers)	12	2	0.167	0	0	0.000
Trolled lures (w/flashers)	70	9	0.129	38	1	0.026
All Gear	242	21	0.087	93	3	0.032
Langara Island						
Motor-mooched herring	95	21	0.221	0	0	0.000
All Areas/All Gears	476	52	0.109	151	10	0.066

Table 12. Summary of holding type and associated mortalities by gear treatment for the 1999 coho catch and release studies.